

AD-A106 312

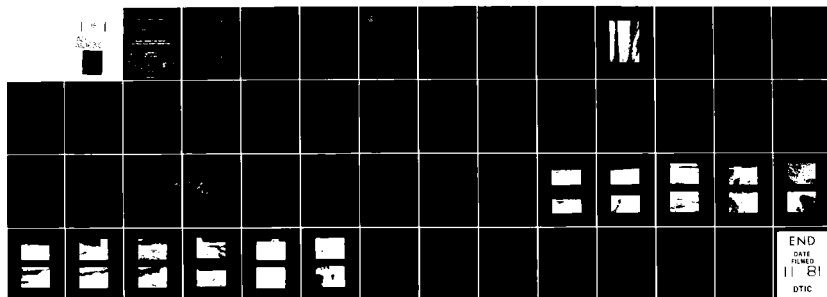
BLACK AND VEATCH KANSAS CITY MO  
NATIONAL DAM SAFETY PROGRAM. LAKE WINNEBAGO DAM (MO 20312); MIS--ETC(U)  
MAY 79 P R ZAMAN, E R BURTON, H L CALLAHAN DACW43-79-C-0040

F/G 13/13

UNCLASSIFIED

DACW43-79-C-0040

NL



**MISSOURI-KANSAS CITY BASIN**

**AD A106312**

**LAKE WINNEBAGO DAM  
CASS COUNTY, MISSOURI  
NO 20012**

**PHASE 1 INSPECTION REPORT  
NATIONAL DAM SAFETY INSPECTION**



**United States Army  
Corps of Engineers  
ENGINEER**

**St. Louis District**

**This document has been approved  
for public release and sale; its  
distribution is unlimited.**

**PREPARED BY: U.S. ARMY ENGINEER DISTRICT, ST. LOUIS**

**FOR STATE OF MISSOURI**

**MAY 1970**

**81 10 20-065**

**FILE COPY**

**RTIC**

**OCT 30 1969**

**A**

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Phase I Dam Inspection Report National Dam Safety Program Lake Winnebago Dam (MO 20312) Cass County, Missouri		5. TYPE OF REPORT & PERIOD COVERED Final Report
6. AUTHOR(s) Black & Veatch, Consulting Engineers		7. PERFORMING ORG. REPORT NUMBER
8. PERFORMING ORGANIZATION NAME AND ADDRESS U.S. Army Engineer District, St. Louis Dam Inventory and Inspection Section, LMSED-PD 210 Tucker Blvd., North, St. Louis, Mo. 63101		9. CONTRACT OR GRANT NUMBER(s) DACW43-79-C-114 ✓
10. CONTROLLING OFFICE NAME AND ADDRESS U.S. Army Engineer District, St. Louis Dam Inventory and Inspection Section, LMSED-PD 210 Tucker Blvd., North, St. Louis, Mo. 63101		11. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS 11
12. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) 10 Paul R. /Zaman Edwin R. /Burton Harry L. /Callahan		13. REPORT DATE May 1979
		14. NUMBER OF PAGES Approximately 55
		15. SECURITY CLASS (of this report) UNCLASSIFIED
		16. DECLASSIFICATION/DOWNGRADING SCHEDULE
17. DISTRIBUTION STATEMENT (of this Report) Approved for release; distribution unlimited.		
18. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report) 6 National Dam Safety Program. Lake Winnebago Dam (MO 20312), Missouri - Kansas City Basin, Cass County, Missouri. Phase I Inspection Report.		
19. SUPPLEMENTARY NOTES		
20. KEY WORDS (Continue on reverse side if necessary and identify by block number) Dam Safety, Lake, Dam Inspection, Private Dams		
21. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.		

FORM 104-101 10/73 EDITION OF 1 NOV 65 IS OBSOLETE

051330

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

## INSTRUCTIONS FOR PREPARATION OF REPORT DOCUMENTATION PAGE

**RESPONSIBILITY** The controlling DoD office will be responsible for completion of the Report Documentation Page, DD Form 1473, in all technical reports prepared by or for DoD organizations.

**CLASSIFICATION** Since this Report Documentation Page, DD Form 1473, is used in preparing announcements, bibliographies, and data banks, it should be unclassified if possible. If a classification is required, identify the classified items on the page by the appropriate symbol.

### COMPLETION GUIDE

**General:** Make Blocks 1, 4, 5, 6, 7, 11, 13, 15, and 16 agree with the corresponding information on the report cover. Leave Blocks 2 and 3 blank.

**Block 1. Report Number:** Enter the unique alphanumeric report number shown on the cover.

**Block 2. Government Accession No.:** Leave blank. This space is for use by the Defense Documentation Center.

**Block 3. Recipient's Catalog Number:** Leave blank. This space is for the use of the report recipient to assist in future retrieval of the document.

**Block 4. Title and Subtitle:** Enter the title in all capital letters exactly as it appears on the publication. Titles should be unclassified whenever possible. Write out the English equivalent for Greek letters and mathematical symbols in the title (see "Abstracting Scientific and Technical Reports of Defense-sponsored RDT & E," AD-667 000). If the report has a subtitle, this subtitle should follow the main title, be separated by a comma or semicolon if appropriate, and be initially capitalized. If a publication has a title in a foreign language, translate the title into English and follow the English translation with the title in the original language. Make every effort to simplify the title before publication.

**Block 5. Type of Report and Period Covered:** Indicate here whether report is interim, final, etc., and, if applicable, inclusive dates of period covered, such as the life of a contract covered in a final contractor report.

**Block 6. Performing Organization Report Number:** Only numbers other than the official report number shown in Block 1, such as series numbers for in-house reports or a contractor/grantee number assigned by him, will be placed in this space. If no such numbers are used, leave this space blank.

**Block 7. Author(s):** Include corresponding information from the report cover. Give the name(s) of the author(s) in conventional order (for example, John R. Doe or, if author prefers, J. Robert Doe). In addition, list the affiliation of an author if it differs from that of the performing organization.

**Block 8. Contract or Grant Number(s):** For a contractor or grantee report, enter the complete contract or grant number(s) under which the work reported was accomplished. Leave blank in in-house reports.

**Block 9. Performing Organization Name and Address:** For in-house reports enter the name and address, including office symbol, of the performing activity. For contractor or grantee reports enter the name and address of the contractor or grantee who prepared the report and identify the appropriate corporate division, school, laboratory, etc., of the author. List city, state, and ZIP Code.

**Block 10. Program Element, Project, Task Area, and Work Unit Numbers:** Enter here the number code from the applicable Department of Defense form, such as the DD Form 1498, "Research and Technology Work Unit Summary" or the DD Form 1634, "Research and Development Planning Summary," which identifies the program element, project, task area, and work unit or equivalent under which the work was authorized.

**Block 11. Controlling Office Name and Address:** Enter the full, official name and address, including office symbol, of the controlling office. Equates to funding/sponsoring agency. For definition see DoD Directive 5200.20, "Distribution Statements on Technical Documents."

**Block 12. Report Date:** Enter here the day, month, and year or month and year as shown on the cover.

**Block 13. Number of Pages:** Enter the total number of pages.

**Block 14. Monitoring Agency Name and Address (if different from Controlling Office):** For use when the controlling or funding office does not directly administer a project, contract, or grant, but delegates the administrative responsibility to another organization.

**Blocks 15 & 15a. Security Classification of the Report: Declassification/Downgrading Schedule of the Report:** Enter in 15 the highest classification of the report. If appropriate, enter in 15a the declassification/downgrading schedule of the report, using the abbreviations for declassification/downgrading schedules listed in paragraph 4-207 of DoD 5200.1-R.

**Block 16. Distribution Statement of the Report:** Insert here the applicable distribution statement of the report from DoD Directive 5200.20, "Distribution Statements on Technical Documents."

**Block 17. Distribution Statement (of the abstract entered in Block 20, if different from the distribution statement of the report):** Insert here the applicable distribution statement of the abstract from DoD Directive 5200.20, "Distribution Statements on Technical Documents."

**Block 18. Supplementary Notes:** Enter information not included elsewhere but useful, such as: Prepared in cooperation with Translation of or by: Presented at conference of: To be published in:

**Block 19. Key Words:** Select terms or short phrases that identify the principal subjects covered in the report, and are sufficiently specific and precise to be used as index entries for cataloging, conforming to standard terminology. The DoD "Thesaurus of Engineering and Scientific Terms" (TEST) AD-672 000, can be helpful.

**Block 20. Abstract:** The abstract should be a brief (not to exceed 200 words) factual summary of the most significant information contained in the report. If possible, the abstract of a classified report should be unclassified and the abstract to an unclassified report should consist of publicly-releasable information. If the report contains a significant bibliography or literature survey, mention it here. For information on preparing abstracts see "Abstracting Scientific and Technical Reports of Defense-Sponsored RDT&E," AD-667 000.

# **MISSOURI-KANSAS CITY BASIN**

**LAKE WINNEBAGO DAM**

**CASS COUNTY, MISSOURI**

**MO 20312**

## **PHASE 1 INSPECTION REPORT NATIONAL DAM SAFETY INSPECTION**



**United States Army  
Corps of Engineers**

*Serving the Army  
Serving the Nation*

**St. Louis District**

**PREPARED BY: U.S. ARMY ENGINEER DISTRICT, ST. LOUIS**

**FOR: STATE OF MISSOURI**

**MAY 1979**



DEPARTMENT OF THE ARMY  
ST. LOUIS DISTRICT, CORPS OF ENGINEERS  
210 NORTH 12TH STREET  
ST. LOUIS, MISSOURI 63101

IN REPLY REFER TO

SUBJECT: Lake Winnebago Dam, Mo. ID No. 20312  
Phase I Inspection Report

This report presents the results of field investigation and evaluation of the Lake Winnebago Dam. It was prepared under the National Program of Inspection of Non-Federal Dams.

This dam has been classified as unsafe, non-emergency by the St. Louis District as a result of the application of the following criteria:

- 1) Spillway will not pass 50 percent of the Probable Maximum Flood
- 2) Overtopping could result in dam failure
- 3) Dam failure significantly increases the hazard to loss of life downstream

SUBMITTED BY:

**SIGNED**  
Chief, Engineering Division

14 MAR 1980

Date

APPROVED BY:

**SIGNED**  
Colonel, CE, District Engineer

4 MAR 1980

Date

By \_\_\_\_\_  
Distribution \_\_\_\_\_  
Approved \_\_\_\_\_

Justification

LAKE WINNEBAGO  
CASS COUNTY, MISSOURI

MISSOURI INVENTORY NO. 20312

PHASE I INSPECTION REPORT  
NATIONAL DAM SAFETY PROGRAM

PREPARED BY:  
BLACK & VEATCH  
CONSULTING ENGINEERS  
KANSAS CITY, MISSOURI

UNDER DIRECTION OF  
ST. LOUIS DISTRICT CORPS OF ENGINEERS  
FOR  
GOVERNOR OF MISSOURI

MAY 1979

PHASE I REPORT  
NATIONAL DAM SAFETY PROGRAM

Name of Dam	Lake Winnebago Dam
State Located	Missouri
County Located	Cass County
Stream	Middle Big Creek
Date of Inspection	24 May 1979

Lake Winnebago Dam was inspected by a team of engineers, from Black & Veatch, Consulting Engineers for the St. Louis District, Corps of Engineers. The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

The guidelines used in the assessment were furnished by the Department of the Army, Office of the Chief of Engineers and developed with the help of several Federal and state agencies, professional engineering organizations, and private engineers. Based on these guidelines, this dam is classified as an intermediate size dam with a high downstream hazard potential. For the Lake Winnebago Dam, the estimated length of the damage zone extends approximately twenty miles downstream of the dam. Within the damage zone are many homes and three buildings.

Our inspection and evaluation indicates the spillway does not meet the criteria set forth in the guidelines for a dam having the above size and hazard potential. The spillway will not pass either the probable maximum flood or 50 percent of the probable maximum flood without overtopping but will pass 25 percent of the probable maximum flood. The spillway will pass the 100-year flood. Based on the size of dam and downstream hazard potential, the spillway should be capable of passing the PMF without overtopping the dam. The probable maximum flood is defined as the flood discharge that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region.

Deficiencies visually observed by the inspection team were areas of minor surface erosion, some minor displacement of the riprap, and seepage.

There were no observed deficiencies or conditions existing at the time of the inspection which indicate an immediate safety hazard. Future corrective action and regular maintenance will be required to correct or control the described deficiencies. In addition, detailed seepage and stability analyses of the existing dam, as required by the guidelines, should be performed. A detailed report discussing each of these deficiencies is attached.



*Paul R. Zaman*

Paul R. Zaman, PE  
Illinois 62-29261

*Edwin R. Burton*

Edwin R. Burton, PE  
Missouri E-10137

*Harry L. Callahan*

Harry L. Callahan, Partner  
Black & Veatch



OVERVIEW OF LAKE AND DAM

PHASE I INSPECTION REPORT  
NATIONAL DAM SAFETY PROGRAM  
LAKE WINNEBAGO DAM

TABLE OF CONTENTS

<u>Paragraph No.</u>	<u>Title</u>	<u>Page No.</u>
SECTION 1 - PROJECT INFORMATION		
1.1	General	1
1.2	Description of Project	1
1.3	Pertinent Data	3
SECTION 2 - ENGINEERING DATA		
2.1	Design	6
2.2	Construction	6
2.3	Operation	6
2.4	Geology	6
2.5	Evaluation	7
SECTION 3 - VISUAL INSPECTION		
3.1	Findings	8
3.2	Evaluation	9
SECTION 4 - OPERATIONAL PROCEDURES		
4.1	Procedures	10
4.2	Maintenance of Dam	10
4.3	Maintenance of Operating Facilities	10
4.4	Description of Any Warning System in Effect	10
4.5	Evaluation	10
SECTION 5 - HYDRAULIC/HYDROLOGIC		
5.1	Evaluation of Features	11
SECTION 6 - STRUCTURAL STABILITY		
6.1	Evaluation of Structural Stability	13
SECTION 7 - ASSESSMENT/REMEDIAL MEASURES		
7.1	Dam Assessment	14
7.2	Remedial Measures	14

TABLE OF CONTENTS (Cont'd)

LIST OF PLATES

<u>Plate No.</u>	<u>Title</u>
1	Location Map
2	Vicinity Topography
3	Plan
4	Cross Sections
5	Spillway Section
6	Outlet Works Section
7	Photo Index

LIST OF PHOTOGRAPHS

<u>Photo No.</u>	<u>Title</u>
1	Crest of dam
2	Upstream face of dam
3	Downstream face of dam
4	Upstream face of dam viewed from left abutment
5	Downstream face of dam viewed from left abutment
6	Overview of backside of dam
7	Sewer line structure
8	Outlet structure
9	Outlet end of outlet pipe
10	Channel below outlet pipe
11	Emergency spillway
12	Emergency spillway looking upstream from sill
13	Emergency spillway looking downstream

LIST OF PHOTOGRAPHS (Cont'd)

<u>Photo No.</u>	<u>Title</u>
14	Emergency spillway channel
15	Emergency spillway overfall
16	Emergency spillway overfall viewed from downstream
17	Channel below emergency spillway
18	Channel below roadway downstream of dam
19	Erosion channel on backside of dam
20	Seepage at right abutment contact
21	Seepage below embankment
22	Seepage from left bank of spillway channel at overfall

APPENDIX

Appendix A - Hydrologic and Hydraulic Computations

## SECTION 1 - PROJECT INFORMATION

### 1.1 GENERAL

a. Authority. The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of safety inspection of dams throughout the United States. Pursuant to the above, the District Engineer of the St. Louis District, Corps of Engineers, directed that a safety inspection of the Lake Winnebago Dam be made.

b. Purpose of Inspection. The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

c. Evaluation Criteria. Criteria used to evaluate the dam were furnished by the Department of the Army, Office of the Chief of Engineers, in "Recommended Guidelines for Safety Inspection of Dams". These guidelines were developed with the help of several Federal agencies and many State agencies, professional engineering organizations, and private engineers.

### 1.2 DESCRIPTION OF PROJECT

#### a. Description of Dam and Appurtenances.

(1) The dam is an earth structure approximately 1,200 feet in length located in the valley of Middle Big Creek approximately 1-1/2 miles south of the Jackson and Cass County line in north central Cass County (Plate 1). The crest width is 30 feet and has an unpaved road along its length. The upstream slope is covered with riprap and the downstream slope has a cover of grass and rock. Topography of the contributing watershed is characterized by rolling hills. Topography in the vicinity of the dam is shown in Plate 2.

(2) The emergency spillway is located in the left abutment. The emergency spillway is a cut in natural rock such that the walls are nearly vertical, the floor flat, and both are composed of limestone. A 2-foot wide concrete sill lies across the emergency spillway near the upstream end. Discharge through the emergency spillway overflows into the natural channel below the dam. The slope from the lower end of the spillway's rock cut to the natural channel is very steep.

(3) A 24-inch steel drain pipe with gate valve runs under the embankment and is located about 200 feet west of the dam's east abutment. Its primary function is to draw down the lake if necessary. Access to the gate valve is through a five-foot diameter concrete control tower located on the upstream dam slope at about the water line. Discharge

from the pipe goes to a riprapped channel which conveys water to the natural channel.

(4) During the period of time Lake Winnebago was drained for repair and reconstruction (see Section 1, paragraph 1.2g and Section 6, paragraph 6.1d for details of the post construction work), a sewerline was placed in the lake bed. A 36" steel pipe was run through the dam near the right abutment. An access manhole is located on the upstream dam slope at about the waterline.

(5) Pertinent physical data are given in paragraph 1.3.

b. Location. The dam is located in north central Cass County, Missouri, as indicated on Plate 1. The lake formed by the dam is shown on the United States Geological Survey 7.5 minute series quadrangle map for Pleasant Hill, Missouri in Sections 4, 5 and 9 of T46N, R31W.

c. Size Classification. Criteria for determining the size classification of dams and impoundments are presented in the guidelines referenced in paragraph 1.1c above. Based on these criteria, the dam and impoundment are in the intermediate size category.

d. Hazard Classification. The hazard classification assigned by the Corps of Engineers for this dam is as follows: The Lake Winnebago Dam has a high hazard potential, meaning that the dam is located where failure may cause loss of life, and serious damage to homes, agricultural, industrial and commercial facilities, and to important public utilities, main highways, or railroads. For the Lake Winnebago Dam, the estimated length of the damage zone extends approximately twenty miles downstream of the dam. Within the damage zone are many homes and three buildings.

e. Ownership. The dam is owned by the Lake Winnebago Development Company, Inc. However, this corporation has been involved in reorganization proceedings under Chapter 10 of the Bankruptcy Act since the fall of 1970. Dale M. Thompson is the court-appointed trustee for this company and his office is in the United Missouri Bank building, 10th and Grand, Kansas City, Missouri. During the past ten years problems with the dam have been handled by the Lake Winnebago Homeowners Association.

f. Purpose of Dam. The dam forms a 315-acre residential development and recreation lake.

g. Design and Construction History. The original design of the dam was by Tibbits-Young, Consulting Engineers, 1519 Sunshine, Springfield, Missouri. This design work was apparently initiated early in 1964 and the final plans were dated April 6, 1964. Tibbits-Young has been reorganized and is now Tibbits-Nachtrab, 1640 St. Louis, Springfield, Missouri 65802. Data relating to the original construction were not available.

However, an October 31, 1965 newspaper article states that the spillway was under construction and the lake was filled to within ten feet of the normal pool. On February 15, 1972 a sink hole was first noticed on the upstream face of the dam in the vicinity of the outlet pipes. On or about August 9, 1973 the Lake Winnebago Home Owners Association hired R. J. Spiegel, P. E., now deceased, as engineer for the repair and reconstruction of Lake Winnebago Dam. The repair and reconstruction work was completed by a "Contractor per task" procedure under the direction of R. J. Spiegel, P. E. Data relating to the design of the reconstruction were not available. Weekly summaries of daily construction records were available for the dam reconstruction.

h. Normal Operating Procedure Normal rainfall, runoff, transpiration, evaporation, and capacity of the uncontrolled spillway all combine to maintain a relatively stable water surface elevation. The gate valve on the drain outlet is operated annually to determine if it is functioning properly.

#### 1.4 PERTINENT DATA

a. Drainage Area - 19.98 square miles

b. Discharge at Damsite

(1) Normal discharge at the damsite is through an uncontrolled spillway.

(2) Estimated experienced maximum flood at damsite - Unknown.

(3) Estimated ungated spillway capacity at maximum pool elevation - 29,150 cfs (Probable Maximum Flood Pool El. 929.9).

c. Elevation (Feet Above M.S.L.)

(1) Minimum top of dam - 924.7 ± (see Plate 3)

(2) Minimum spillway crest - 918.1 ± (see Plate 5)

(3) Streambed at centerline of dam - 861.2 ±

(4) Maximum tailwater - Unknown.

d. Reservoir

(1) Length of maximum pool - 12,000 feet ±

(2) Length of normal pool - 10,100 feet ±



e. Storage (Acre-feet).

- (1) Top of dam - 7,150
- (2) Emergency spillway crest - 4,670
- (3) Design surcharge - Not available.

f. Reservoir Surface (Acres).

- (1) Top of dam - 390
- (2) Emergency spillway crest - 315

g. Dam.

- (1) Type - Earth embankment
- (2) Length - 1,200 ± feet
- (3) Height - 64 feet ±
- (4) Top width - 30 feet
- (5) Side slopes - Varies (see Plate 4).
- (6) Zoning - Dam is composed of three zones. The upstream and downstream zones are brown clay and the central impervious zone is red clay. The material was locally available. The material descriptions are as shown on the design drawings. The material origins are not known.
- (7) Impervious core - The dam has an impervious red clay core which is 30 feet wide at the top and 100 feet wide at the bottom.
- (8) Cutoff - The bottom of the clay core forms a cutoff into the foundation rock.
- (9) Grout curtain - None.
- (10) Internal drainage system - Horizontal sand blanket.

h. Diversion and Regulating Tunnel - None.

i. Spillway.

- (1) Type - Rock cut open channel.

- (2) Width of spillway - 330 feet.
- (3) Crest elevation - 918.1 feet m.s.l. (see Plate 5).
- (4) Gates - None.
- (5) Upstream channel - Rock cut in natural limestone.
- (6) Downstream channel - Rock cut in natural limestone with abrupt drop through rock rubble to natural channel.

J. Outlet Works. A 24-inch steel drain pipe lies under the embankment about 200 feet west of the dam's east abutment. Discharge through the pipe is regulated by a gate valve. Downstream from the pipe, a riprapped channel carries the water to the natural channel.

## SECTION 2 - ENGINEERING DATA

### 2.1 DESIGN

Little design data were available for the original construction. The following are the items included in the Lake Winnebago Dam folder. A report titled "Specifications - Lake Winnebago Dam, Lake Winnebago Development Co. Inc., Tibbits - Young, Consulting Engineers, April 6, 1964." Included in this report were the results of soil tests by the General Testing Laboratories, 1517 Walnut St., Kansas City, Missouri. There are calculations on determining peak runoff, stream flow and flood routing, and cross sections of the natural stream channel. There is a file on quantity and cost estimates and one on specifications.

No design data were available on the dam reconstruction. A complete set of specifications for the reconstruction, prepared by R.J. Spiegel, PE, now deceased, was available. Design drawings were obtained for the original construction of Lake Winnebago Dam, the reconstruction, and the sewer line.

### 2.2 CONSTRUCTION

No records were available on the original construction. However, the dam was apparently completed in the fall of 1965. Weekly summaries of daily construction records were available for the dam reconstruction.

### 2.3 OPERATION

No operation records were available.

### 2.4 GEOLOGY

The dam is located across a broad shallow valley formed in shale and limestone of the Pleassanton and Kansas City Groups of the Pennsylvanian System. The design drawings indicate that the abutments of the dam are in the Swope, Ladore, and Hertha formations of the Kansas City Group and the Upper Unnamed formation of the Pleassanton Group and that the foundation of the dam is in the Upper Unnamed formation of the Pleassanton Group. The Swope and Hertha formations are predominantly limestone with several thin shale units, and the Ladore and Upper Unnamed formations are shale. No sinks were observed in the limestone units.

The soils of the reservoir and dam area consist of the Blackoar-Zook and Polo-Sogn soil associations. The Blackoar-Zook soil association is an alluvial soil developed along the stream course. The surface soil is black to gray and the subsoil is gray, brown, and yellow. The Polo-Sogn soil association is developed from loess over shales or limestones. The surface soil is dark gray to dark brown. The subsurface

soil is red below 3 feet of depth. The design drawings indicate that the soil in the valley consists of brown to gray silty clay with some sand of probable alluvial origin. For engineering purposes the soils in the reservoir and dam area are classified as CL according to published literature.

## 2.5 EVALUATION

- a. Availability. Data that were available are described in 2.1.
- b. Adequacy. The engineering data that were available were not adequate to make a detailed assessment of the design, construction, and operation. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record.
- c. Validity. The validity of the design, construction, and operation could not be determined due to the lack of engineering data.

### SECTION 3 - VISUAL INSPECTION

#### 3.1 FINDINGS

a. General. A visual inspection of Lake Winnebago Dam was made on 24 May 1979. The inspection team included professional engineers with experience in dam design and construction, hydrology, hydraulic engineering, and geotechnical engineering. This dam appeared to be in good condition. Specific observations are discussed below. No observations were made of the condition of the upstream face of the dam below the pool elevation at the time of the inspection.

b. Dam. The inspection team observed the following items at the dam. In general, the embankment appeared to be in good condition. Maintenance of the dam was evident as all small trees had been cut. Slope protection on the front face of the dam consisted of riprap and grass. There was minor displacement and loss of riprap. The downstream slope is protected by grass and rock fill. Some erosion was observed where water accumulates on the bench between Station 1+00 and Station 3+00 (see Plate 3). The maximum width and depth of erosion was between 1.5 and 2 feet. Seepage was observed downstream of the dam and at the left and right abutments. All observed seepage was clear and was of a magnitude of less than 1 gpm. Seepage was suspected around the outlet works into the outlet channel. There was no evidence of animal burrows, sliding, cracking, settlement, sinkholes, rutting, or potholes. There is no need for re-vegetation.

c. Appurtenant Structures. The inspection team observed the following items pertaining to appurtenant structures. The emergency spillway consists of a channel cut in natural rock at the left abutment. The channel is 330 feet wide with nearly vertical walls and ends with an abrupt drop through rock rubble to the natural channel. There is evidence of erosion or undercutting of the limestone ledge at a 4:1 slope at the end of this channel. Otherwise the walls and floor of the channel are in good condition. The outlet conduit consists of a 24-inch steel pipe with a gate valve. The gate valve is operated annually to assure proper function. Access to the gate valve is through a five foot diameter concrete control tower with a cover and lock. The drain pipe was observable through the control tower and about 20 feet of the downstream inside of the pipe was observed. The pipe appeared to be in good condition with no apparent distortion. The drain pipe discharges into a channel which discharges into the natural channel. This constructed channel is riprapped and in good condition.

d. Geology. A visual inspection of the geology and soils in the immediate vicinity of the dam confirmed the data shown on the design drawings that could be checked without subsurface investigation. The spillway is cut into the Bethany Falls limestone, Hushpuckney shale and Middle Creek limestone members of the Swope formation. The discharge

channel from the end of the spillway is in the upper unnamed shale formation of the Pleasanton Group. It is anticipated that the foundation is also in this unit. The abutments of the dam are in the Swope, Ladore, Hertha and Upper Unnamed formations of the Kansas City and Pleasanton Groups. The embankment consists of CL material as classified in the field from a near surface sample. The soils in the area around the dam are silty clay residual soils (CL) on the hills and slopes and alluvial silty clay along the discharge channel downstream of the dam. Some areas of rock outcrop are void of soil, and in other areas the shale is severely weathered to a silty clay when exposed at the surface.

e. Reservoir Area. No slides or excessive erosion due to wave action were observed along the shore of the reservoir.

f. Downstream Channel. The natural channel downstream from the primary spillway consists of a gravel streambed. Some outcropping of shale and limestone is visible along the banks. The stream banks are covered with brush and trees.

### 3.2 EVALUATION

The riprap should be maintained on the upstream slope in order to remain adequate. Cutting of the grass and brush on the embankment should be continued. The seepage does not appear likely to become a problem. The erosion may be a problem in the future. Both the seepage and the erosion should be monitored regularly.

## SECTION 4 - OPERATIONAL PROCEDURES

### 4.1 PROCEDURES

The pool is normally controlled by rainfall, runoff, evaporation, and capacity of the uncontrolled spillway.

### 4.2 MAINTENANCE OF DAM

There is no regularly scheduled program for maintenance. Grass and brush on the embankment are cut periodically as needed. The dam is inspected periodically by a committee of the Homeowners Association.

### 4.3 MAINTENANCE OF OPERATING FACILITIES

The drain gate valve is operated annually.

### 4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

There is no existing system or preplanned scheme for warning occupants of the hazard zone below this dam.

### 4.5 EVALUATION

Some areas of minor erosion, seepage and displacement of riprap exist on the embankment. If these deficiencies are unchecked, they could lead to deterioration of the dam embankment.

## SECTION 5 - HYDRAULIC/HYDROLOGIC

### 5.1 EVALUATION OF FEATURES

a. Design Data. Design data pertaining to hydrology and hydraulics were limited in scope and were performed prior to the construction of Raintree Lake upstream of Lake Winnebago. Independent calculations were performed for the report in accordance with the referenced guidelines.

b. Experience Data. The drainage area and lake surface area are developed from USGS Pleasant Hill and Raymore Quadrangle Maps. The spillway and dam layouts are from surveys made during the inspection and available drawings of the original plans and spillway reconstruction.

c. Visual Observations.

(1) The spillway is located in the left abutment and is in good condition. There is some undercutting of the rock ledge at the point where the spillway channel drops sharply to the natural stream channel.

(2) The 24-inch outlet pipe can be used to draw down the pool. The valve to the pipe is operated annually and appears to be in good condition.

(3) Spillway discharges are not anticipated to endanger the integrity of the dam.

d. Overtopping Potential. The spillway will not pass the probable maximum flood without overtopping. The probable maximum flood is defined as the flood discharge that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. The spillway will pass 25 percent of the probable maximum flood without overtopping. The spillway will also pass the 100-year flood estimated to be 6,175 cfs developed by a 24 hour, 100-year rainfall. The rainfall distribution for the 100-year frequency storm was supplied by the St. Louis District, Corps of Engineers. According to the recommended guidelines from the Department of the Army, Office of the Chief of Engineers, a high hazard dam of intermediate size should pass the probable maximum flood. The portion of the estimated peak discharge of the probable maximum flood overtopping the dam would be 37,250 cfs. The remaining 29,150 cfs of the total discharge from the reservoir of 66,400 cfs passes through the emergency spillway. The estimated duration of overtopping is 8.2 hours at a maximum depth of 5.2 feet over the dam. The portion of the estimated peak discharge of 1/2 of the probable maximum flood overtopping the dam would be 10,120 cfs of the total discharge of the reservoir of 29,960 cfs. The remaining 19,840 cfs passes through the emergency spillway. The estimated duration of overtopping is 4.8 hours at a maximum depth of 2.3 feet over the



dam. Due to observed evidence of erodability of the embankment surface soils, it is anticipated that severe erosion and possible failure would occur as the result of prolonged overtopping of the dam. Failure of Raintree Lake upstream of Lake Winnebago would have a significant impact on the hydrologic or hydraulic analysis.

For the Lake Winnebago Dam, the estimated length of the damage zone extends approximately twenty miles downstream of the dam. Within the damage zone are many homes and three buildings.

## SECTION 6 - STRUCTURAL STABILITY

### 6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations. Visual observations of conditions which affect the structural stability of this dam are discussed in Section 3, paragraph 3.1b.

b. Design and Construction Data. No design data relating to the structural stability of the dam were found.

The dam was originally constructed as an earthfill dam and subsequently reinforced with the addition of rock across the entire downstream slope.

c. Operating Records. No operational records exist.

d. Post Construction Changes. Post construction changes included the installation of a sewer through the right abutment, and the reconstruction of the spillway and outlet works. The development of a two-phase reconstruction program was undertaken after several deficiencies were discovered in the integrity of the Winnebago Dam. The first phase involved the renovation of the outlet works. This work included the insertion of a 24-inch steel liner pipe into the existing east 30-inch C.M.P., grouting the space around the steel pipe, construction of the control tower, and grouting full the existing west 30-inch C.M.P. This portion of the work was completed in the spring of 1975. The sewer was installed in late 1975 during construction of the Middle Big Creek Interceptor Sewer for the Village of Lake Winnebago. The sewer was installed prior to the refilling of Lake Winnebago after the first phase of reconstruction. The second phase of reconstruction required the expansion of the existing spillway to accommodate anticipated flows. Rock excavated from the enlarged spillway area was placed across the entire downstream slope of the dam.

e. Seismic Stability. The dam is located in Seismic Zone 1 which is a zone of minor seismic risk. A properly designed and constructed earth dam using sound engineering principles and conservatism should pose no serious stability problems during earthquakes in this zone.

Adequate descriptions of embankment design parameters, foundation and abutment conditions, or static stability analyses to assess the seismic stability of this embankment were not available which is a deficiency. Therefore no inferences will be made regarding the seismic stability.

## SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

### 7.1 DAM ASSESSMENT

a. Safety. Several items noted during the visual inspection by the inspection team that should be monitored or controlled are seepage, areas of minor erosion, and minor displacement of the riprap. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.

b. Adequacy of Information. Due to the lack of engineering design data, the conclusions in this report were based only on performance history and visual conditions. The inspection team considers that these data are sufficient to support the conclusions herein. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available which is considered a deficiency.

c. Urgency. A program should be developed as soon as possible to monitor at regular intervals the deficiencies described in this report. The remedial measures recommended in paragraph 7.2 should be accomplished in the near future. The item recommended in paragraph 7.2a should be pursued on a high priority basis.

d. Necessity for Phase II. The Phase I investigation does not raise any serious questions relating to the safety of the dam or identify any serious dangers that would require a Phase II investigation.

e. Seismic Stability. This dam is located in Seismic Zone 1. Adequate description of embankment design parameters, foundation and abutment conditions, or static stability analyses to assess the seismic stability of this embankment were not available and therefore no inferences will be made regarding the seismic stability. An assessment of the seismic stability should be included as part of the stability analysis required by the guidelines.

### 7.2 REMEDIAL MEASURES

a. Alternatives. The present spillway has the capacity to pass 25 percent of the probable maximum flood without overtopping the dam. In order to pass the probable maximum flood as required by the Recommended Guidelines, the spillway should be modified to increase its capacity and/or the height of dam would need to be increased or the lake level would need to be lowered to increase storage capacity.

b. Operation and Maintenance Procedures. The following operation and maintenance procedures are recommended:

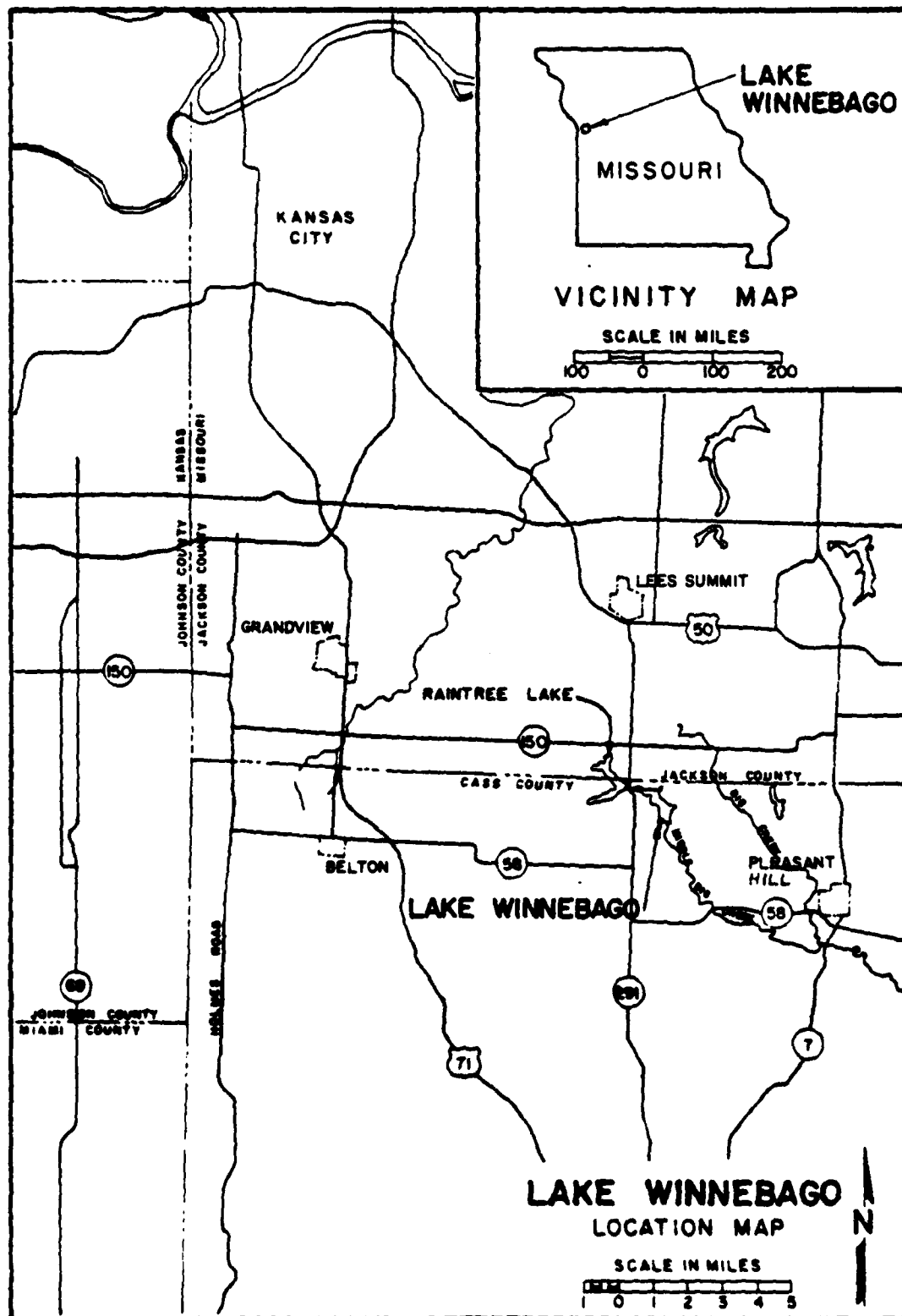
(1) Erosion protection should be maintained on the upstream slope of the dam to prevent erosion of the embankment material due to wave action.

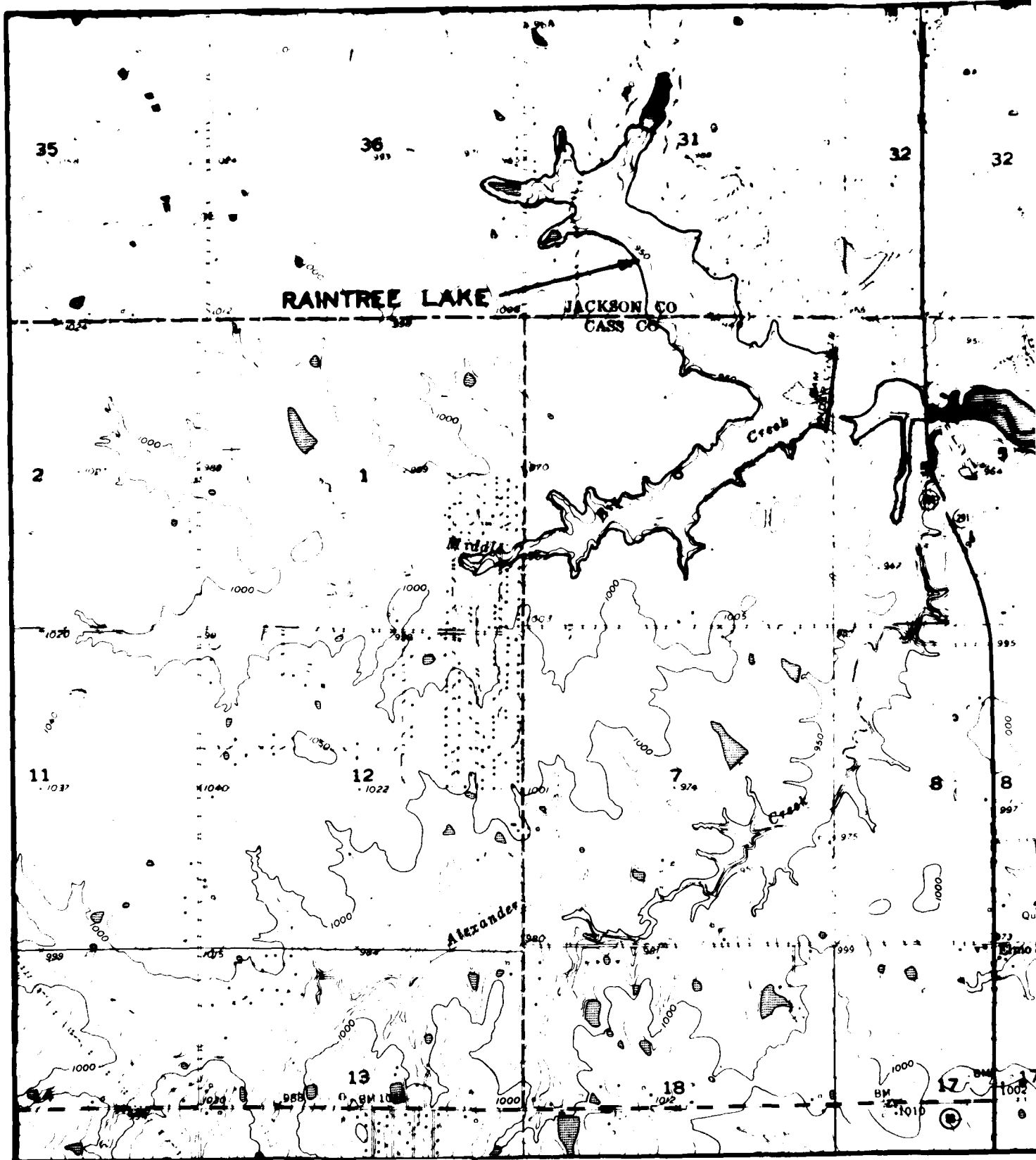
(2) Check the downstream face of the dam periodically for seepage and stability problems. If increased seepage flows are observed or sloughing on the downstream embankment slope is noted, the dam should immediately be inspected and the condition evaluated by an engineer experienced in design and construction of earthen dams.

(3) The grass cover of the embankment should be maintained and areas of minor surface erosion repaired and seeded as required to protect the embankment material.

(4) A detailed inspection of the dam should be made periodically by an engineer experienced in design and construction of dams. More frequent inspections may be required if additional deficiencies are observed or the severity of the reported deficiencies increases.

(5) Seepage and stability analyses should be performed by a professional engineer experienced in the design and construction of dams.





# LAKE WINNEBAGO

VICINITY TOPOGRAPHY

SCALE IN FEET

2000 1000 0 2000 4000

N

32

32

33

JACKSON CO  
CASS CO

Subs. LAKE WINNEBAGO

Brush College No 2 Sch  
(Abandoned)

10

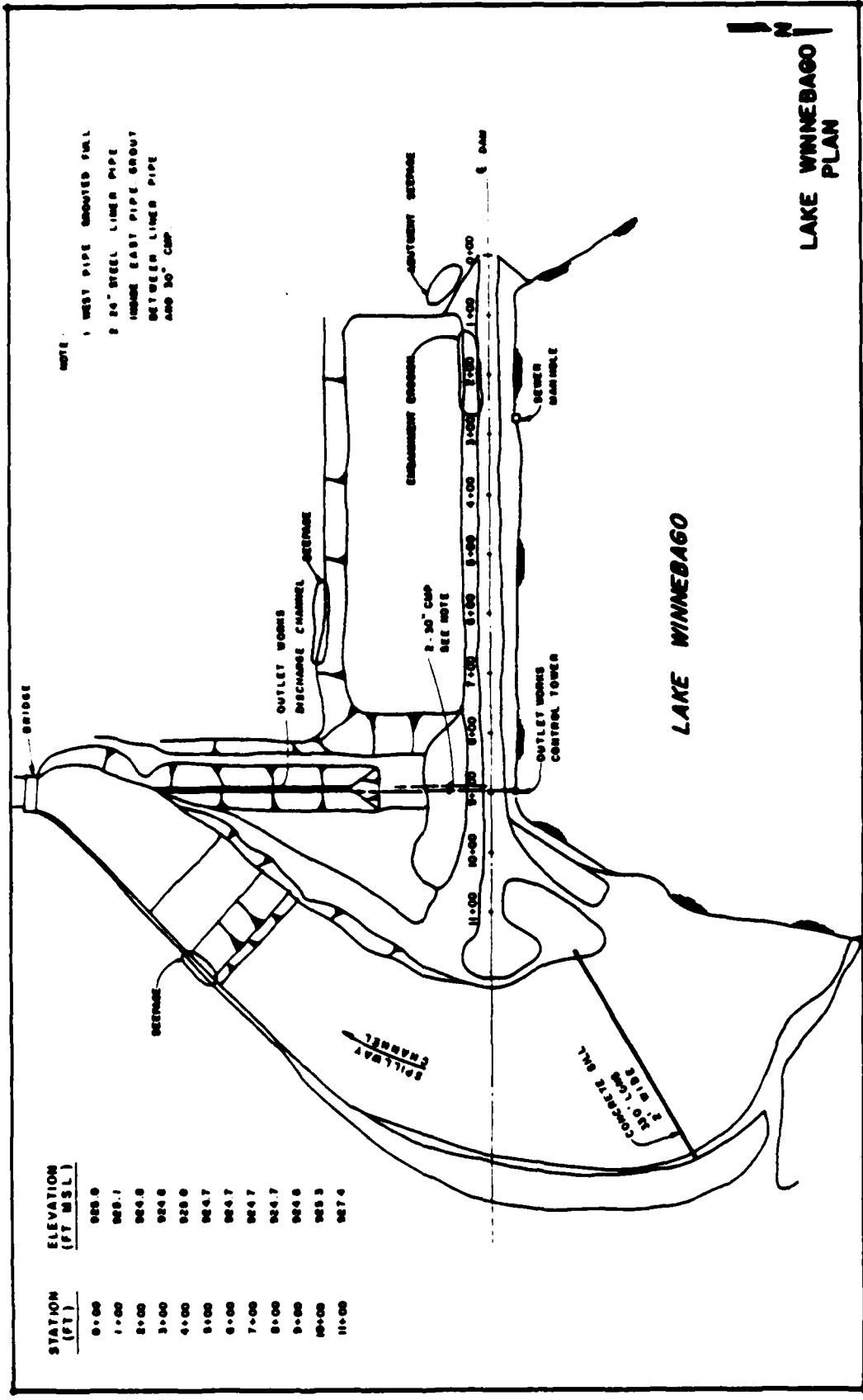
Middle Lake

Big

16

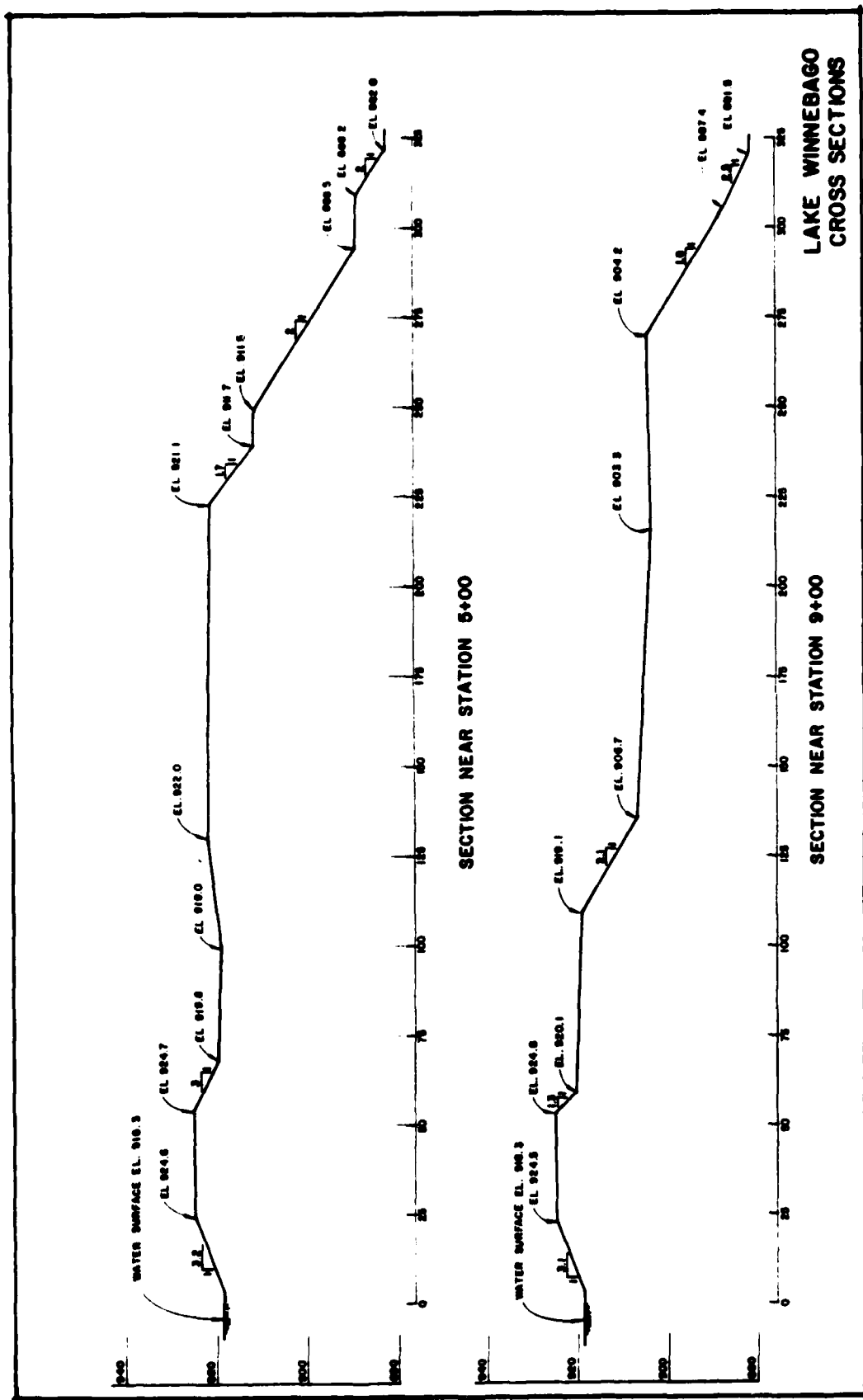
15

PLATE 2

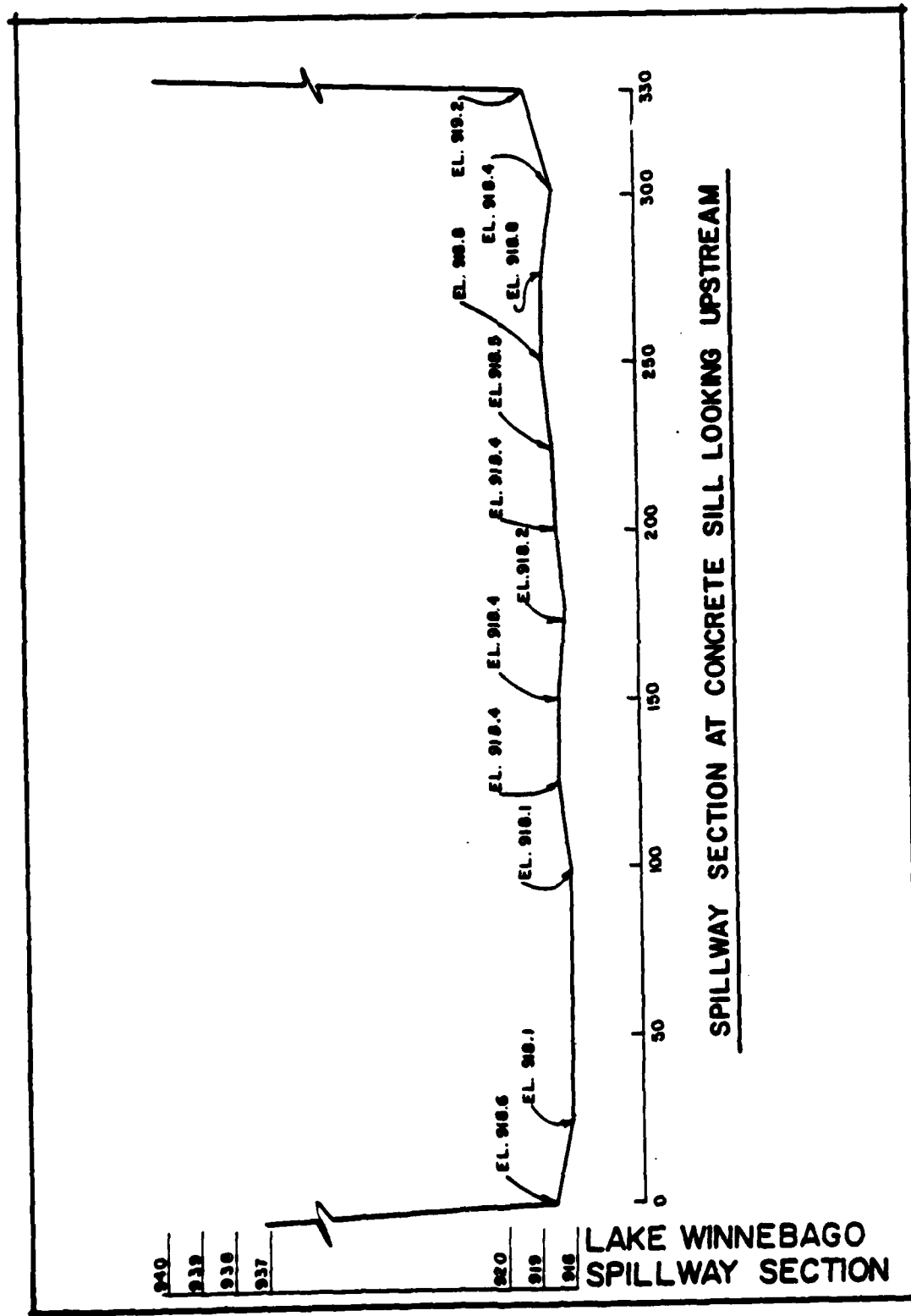


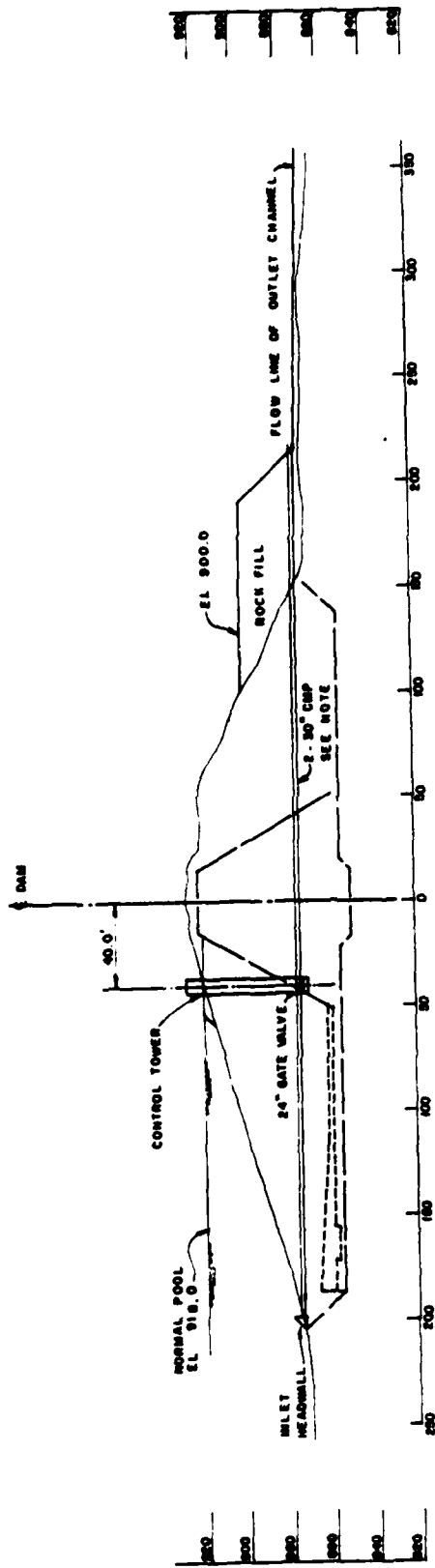
LAKE WINNEBAGO  
PLAN





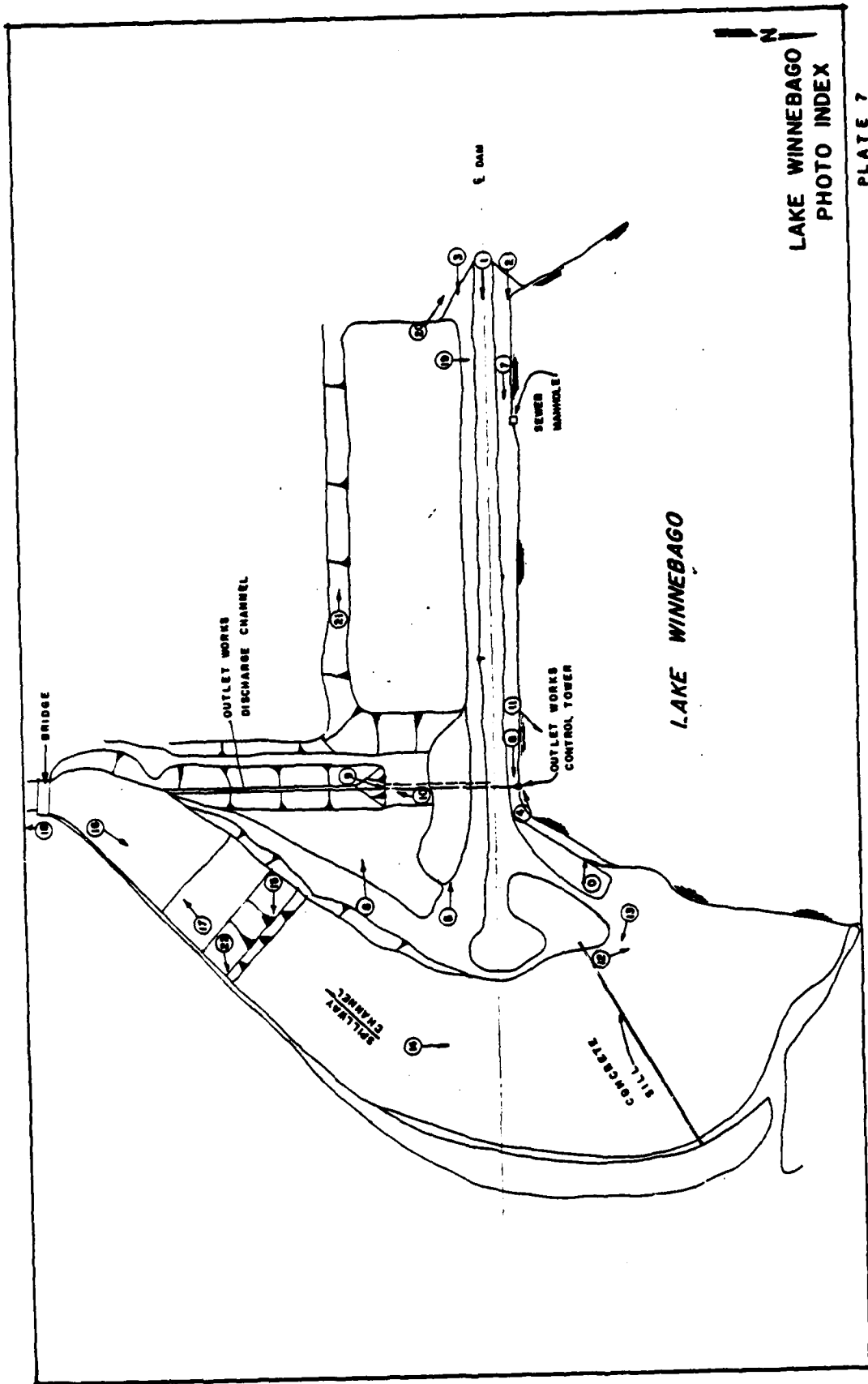
LAKE WINNEBAGO  
CROSS SECTIONS





NOTES WEST PIPE GROUTED FULL  
 2. 24" STEEL LINER PIPE PLACED  
 INSIDE EAST PIPE. GROUT BETWEEN  
 LINER AND 30" CMP.

# LAKE WINNEBAGO OUTLET WORKS SECTION



LAKE WINNEBAGO  
PHOTO INDEX

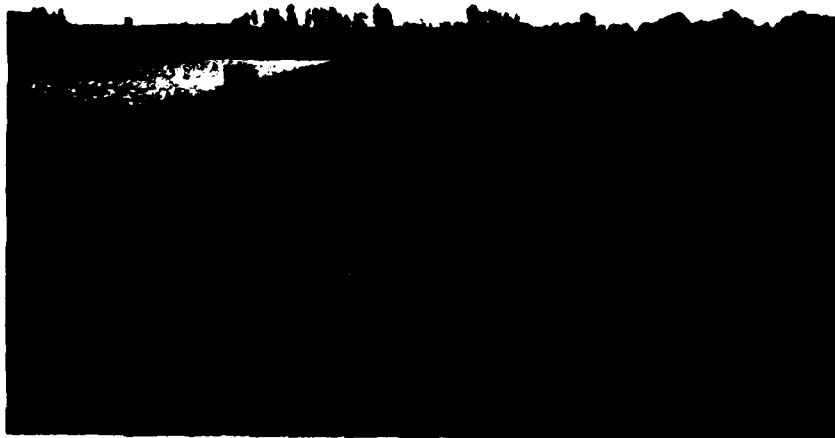


PHOTO 1: CREST OF DAM



PHOTO 2: UPSTREAM FACE OF DAM



PHOTO 3: DOWNSTREAM FACE OF DAM



PHOTO 4: UPSTREAM FACE OF DAM VIEWED FROM LEFT ABUTMENT



PHOTO 5: DOWNSTREAM FACE OF DAM VIEWED FROM LEFT ABUTMENT



PHOTO 6: OVERVIEW OF BACK SIDE OF DAM



PHOTO 7: SEWER LINE STRUCTURE



PHOTO 8: OUTLET STRUCTURE





PHOTO 9: OUTLET END OF OUTLET PIPE

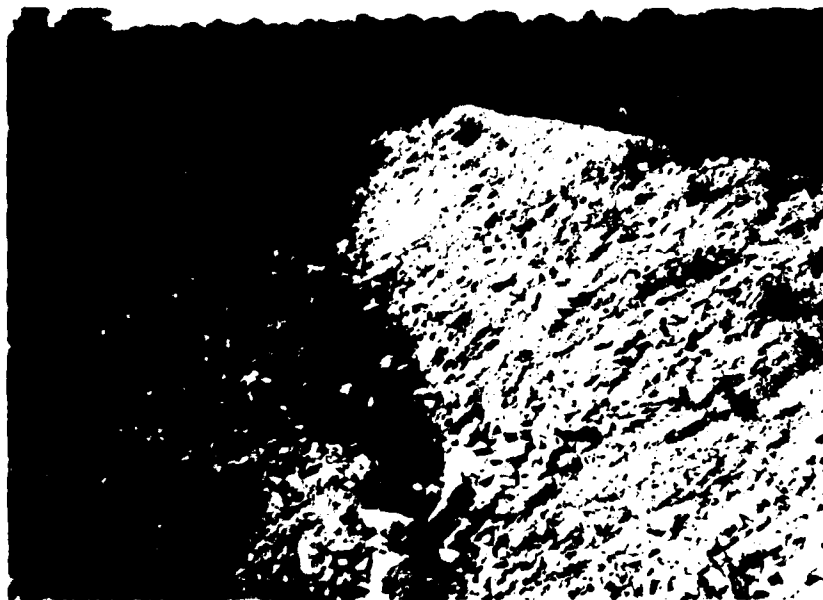


PHOTO 10: CHANNEL BELOW OUTLET PIPE



PHOTO 11: EMERGENCY SPILLWAY



PHOTO 12: EMERGENCY SPILLWAY LOOKING UPSTREAM FROM SILL



PHOTO 13: EMERGENCY SPILLWAY LOOKING DOWNSTREAM



PHOTO 14: EMERGENCY SPILLWAY CHANNEL



PHOTO 15: EMERGENCY SPILLWAY OVERFALL



PHOTO 16: EMERGENCY SPILLWAY OVERFALL VIEWED FROM DOWNSTREAM



PHOTO 17: CHANNEL BELOW EMERGENCY SPILLWAY



PHOTO 18: CHANNEL BELOW ROADWAY DOWNSTREAM OF DAM



PHOTO 19: EROSION CHANNEL ON BACK SIDE OF DAM



PHOTO 20: SEEPAGE AT RIGHT ABUTMENT CONTACT



PHOTO 21: SEEPAGE BELOW EMBANKMENT



PHOTO 22: SEEPAGE FROM LEFT BANK OF SPILLWAY CHANNEL  
AT OVERFALL

**APPENDIX A**  
**HYDROLOGIC AND HYDRAULIC COMPUTATIONS**



## HYDROLOGIC AND HYDRAULIC COMPUTATIONS

1. The Soil Conservation Service (SCS) dimensionless unit hydrograph and HEC-1 (1) were used to develop the inflow hydrographs. Hydrologic inputs are as follows:

a. Forty-eight hour, probable maximum precipitation determined from U.S. Weather Bureau Hydrometeorological Report No. 33.

200 square mile, 24 hour rainfall inches - 24.8

12.53 square mile, 6 hour percent of 24 hour  
200 square mile rainfall - 99%

12.53 square mile, 12 hour percent of 24 hour  
200 square mile rainfall - 118%

12.53 square mile, 24 hour percent of 24 hour  
200 square mile rainfall - 128%

12.53 square mile, 48 hour percent of 24 hour  
200 square mile rainfall - 138%

b. Drainage area = 19.98 square miles (includes 7.45 square miles above Raintree Lake Dam).

c. Time of concentration:  $T_c = (11.9 \times L^3/H)^{0.385} = 3.22$  hours = 193 minutes (L = length of longest watercourse in miles, H = elevation difference in feet) (2)

d. The soil associations in this watershed are Polo-Sogn, Sharpsburg-Higginsville, Blackoak-Zook, and Dennis-Roseland. The percentages of soils in each of the SCS soil groups are as follows: 60% in group C, 35% in group B, and 5% in group D (3).

e. Losses were determined in accordance with SCS methods for determining runoff using a curve number of 86 for antecedent moisture condition III and a curve number of 72 for antecedent moisture condition II. The major land uses in the watershed were low-density urban, row crops, pasture-range, and woods.

2. Spillway discharges were based on backwater analysis using cross sections from the plans for spillway alteration and computer program HEC-2, (4).

Discharge rates over the top of the dam are based on the weir equation:

$$Q = CLH^{1.5} \quad (C = 3.0 \text{ to } 3.06, L = 1,000 \text{ to } 1,200 \text{ feet, } H \text{ is head over the dam}).$$

3. The elevation-storage relationship above normal pool elevation was constructed by planimetering the area enclosed within each contour above normal pool. The storage between two elevations was computed by multiplying the average of the areas at the two elevations by the elevation difference. The summation of these increments below a given elevation is the storage below that level.

4. Floods are routed through the spillway using HEC-1, modified Puls to determine the capability of the spillway.

- (1) U.S. Army Corps of Engineers, Hydrologic Engineering Center, Flood Hydrograph Package (HEC-1), Dam Safety Version, September 1978, Davis, California.
- (2) U.S. Department of the Interior, Bureau of Reclamation, Design of Small Dams, 1974, Washington, D.C.
- (3) Mid-America Regional Council, Regional Soils Guide, March 1976, Kansas City, Missouri.
- (4) U.S. Army Corps of Engineers, Hydrologic Engineering Center, Water Surface Profiles (HEC-2), November 1976, Davis, California.

MISSOURI DAM INSPECTIONS									
A1	A2	A3	B	B1	B2	J1	K	K1	M
PPF ROUTING FOR LAKE WINNEBAGO									
DRAINAGE AREA = 12.33 SQ MI									
0 10 0 0 0 0 0 0 0 0									
288 0 10 0 0 0 0 0 0 0									
5 1 1 1 1 1 1 1 1 1									
J1 -2 -25 -3 -35 -4 -5 -75 -8 1-									
K 0 1 3 3 3 3 3 3 3									
K1 RAINTREE LAKE DAM (48HR. PROBABLE MAXIMUM RUNOFF)									
M 1 2 7.452 1 1 1 1 1 1									
P 25.0 101 120 130 140 140 140 140 140									
T -1 -82 -1 -82 -1 -82 -1 -82 -1									
W2 0.72 1 1 1 1 1 1 1 1									
K 1 2 1 1 1 1 1 1 1									
K1 ROUTING THROUGH RAINTREE LAKE RESERVOIR									
Y 1 1 1 1 1 1 1 1 1									
V1 1 1 1 1 1 1 1 1 1									
V4955.0 956.0 956.6 957.9 958.9 960.2 961.3 962.3 963.2 963.5									
V4963.7 963.9 964.1 964.6 965.0 965.3 965.8 966.5 967.5 967.5									
V5 0. 500. 1000. 2500. 4000. 6000. 8000. 10000. 12000. 12500.									
V513000.13500. 14000. 15000. 16019. 17294. 19688. 26760. 37105.									
SS 0. 9.5 226. 888.5 2255.5 4877. 9651.5									
SE910. 920. 930. 940. 950. 960. 970. 970. 970.									
SS-955.0 0. 1.5 0. 1 3 3 1									
SD 964.9 0. 1.5 0. 1 3 3 1									
K MAIN									
K1 LAKE WINNEBAGO-UNREGULATED INFLOW - 48 HOUR PMF									
M 1 212.53 1 1 1 1 1 1 1									
P 24.8 99. 118. 128. 138. 138. 138. 138. 138.									
T 1 1 1 1 1 1 1 1 1									
W2 1.93 1 1 1 1 1 1 1 1									
X 1 1 1 1 1 1 1 1 1									
K HEAD									
K1 COMBINE WATERSHED RUNOFF AND RAINTREE LAKE OUTFLOWS									
K 1 1 1 1 1 1 1 1 1									
K1 ROUTE-COMBINED-PMF THROUGH LAKE WINNEBAGO DAM									
Y 1 1 1 1 1 1 1 1 1									
V1 1 1 1 1 1 1 1 1 1									
V4918. 919.3 920.4 921.4 922.7 923.5 924.7 925.4 927.1 928.7									
V4930.1 1000. 3000. 5000. 8000. 10000. 13000. 16650. 30650. 49440.									
V50. 1000. 3000. 5000. 8000. 10000. 13000. 16650. 30650. 49440.									
V569390. 2900. 6930. 12570.									
SS 0. 2900. 6930. 12570.									
SE910. 920. 930. 940.									
SS918. 920. 930. 940.									
SD924.7 920. 930. 940.									
K 99 99 99 99 99 99 99 99 99									

1 RUNOFF HYDROGRAPH AT  
2 ROUTE HYDROGRAPH TO  
MAIN RUNOFF HYDROGRAPH AT  
COMBINE 2 HYDROGRAPHS AT  
HEAD-  
DAM ROUTE HYDROGRAPH TO  
END OF NETWORK

\*\*\*\*\*  
 FLOOD HYDROGRAPH—AC AC (HEC-1)  
 DAM SAFETY VERS JULY 1978  
 LAST MODIFICATION 26 FEB 79  
 \*\*\*\*\*

RUN DATE 08/13/79  
 TIME 16.46.22.

MISSOURI DAM INSPECTIONS  
 PMF ROUTING FOR LAKE WINNEBAGO  
 DRAINAGE AREA = 12.53 SQ MI

NO NMR NMN IDAY IHR IMIN METRC IPLY IPRT NSTAM  
 288 0 10 0 0 0 0 0 0 0 0  
 JOPT 5  
 NUT LROPT TRACE  
 0 0 0

MULTI-PLAN ANALYSES TO BE PERFORMED  
 MPLAN=1 NRTIO=9 LRTIO=1

RTIOS= .20 .25 .30 .35 .40 .50 .75 .80 1.00

\*\*\*\*\*

SUB-AREA RUNOFF COMPUTATION

RAINTREE LAKE DAM (48HR PROBABLE MAXIMUM RUNOFF)

ISTAG ICOMP IECON ITAPE JPLY JPRT INAME ISTAGE IAUTO  
 1 0 0 0 0 3 1 0 0

HYDROGRAPH DATA  
 INYDG IUNG TAREA SNAP TRSDA TRSPC RATIO ISHOW ISAME LOCAL  
 1 2 7.45 0.00 7.45 1.00 0.000 0 0 0

PRECIP DATA

SPFE PMS R6 R12 R24 R48 R72 R96  
 C.00 25.00 101.00 120.00 130.00 140.00 0.00 0.00

LOSS DATA

LROPT STKR DLTKR RTIOL ERAIN STRKS RTIOK STRIL CNSTL ALSMX RTIMP  
 0 0.00 0.00 1.00 0.00 0.00 1.00 -1.00 -82.00 0.00 0.00

CURVE NO = -82.00 WETNESS = -1.00 EFFECT CN = 82.00

UNIT HYDROGRAPH DATA

TC= 0.00 LAG= .72

RECESSION DATA

STRTO= 0.00 QRSN= 0.00 RTIOR= 1.00

UNIT HYDROGRAPH 24 END OF PERIOD ORDINATES, TC= 0.00 HOURS, LAG= .72 VOL= 1.00  
 478. 1496. 3119. 4248. 4465. 4027. 3261. 2242. 1567. 1133.  
 817. 578. 414. 294. 209. 150. 107. 76. 55. 41.  
 10. 20. 10. 1.

# SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .. .. .

ELEVATION	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
STORAGE	918.00	918.00	924.70
OUTFLOW	2320.	2320.	4794.
	0.	0.	13000.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.20	923.37	0.00	4258.	9672.	0.00	43.00	0.00
.25	924.44	0.00	4690.	12352.	0.00	43.00	0.00
.30	925.27	.57	5023.	15965.	2.17	42.83	0.00
.35	925.80	1.10	5236.	19917.	3.17	42.50	0.00
.40	926.22	1.52	5407.	23417.	3.83	42.33	0.00
.50	927.02	2.32	5727.	29955.	4.83	42.17	0.00
.75	928.47	3.77	6314.	46745.	7.00	42.00	0.00
.80	928.76	4.06	6428.	50225.	7.17	42.00	0.00
1.00	929.89	5.19	6896.	66409.	8.17	41.67	0.00

END

DATE  
FILMED

11-81

DTIC